

Integrating Wind at PJM

Windiana 2010
Indianapolis
July 21, 2010

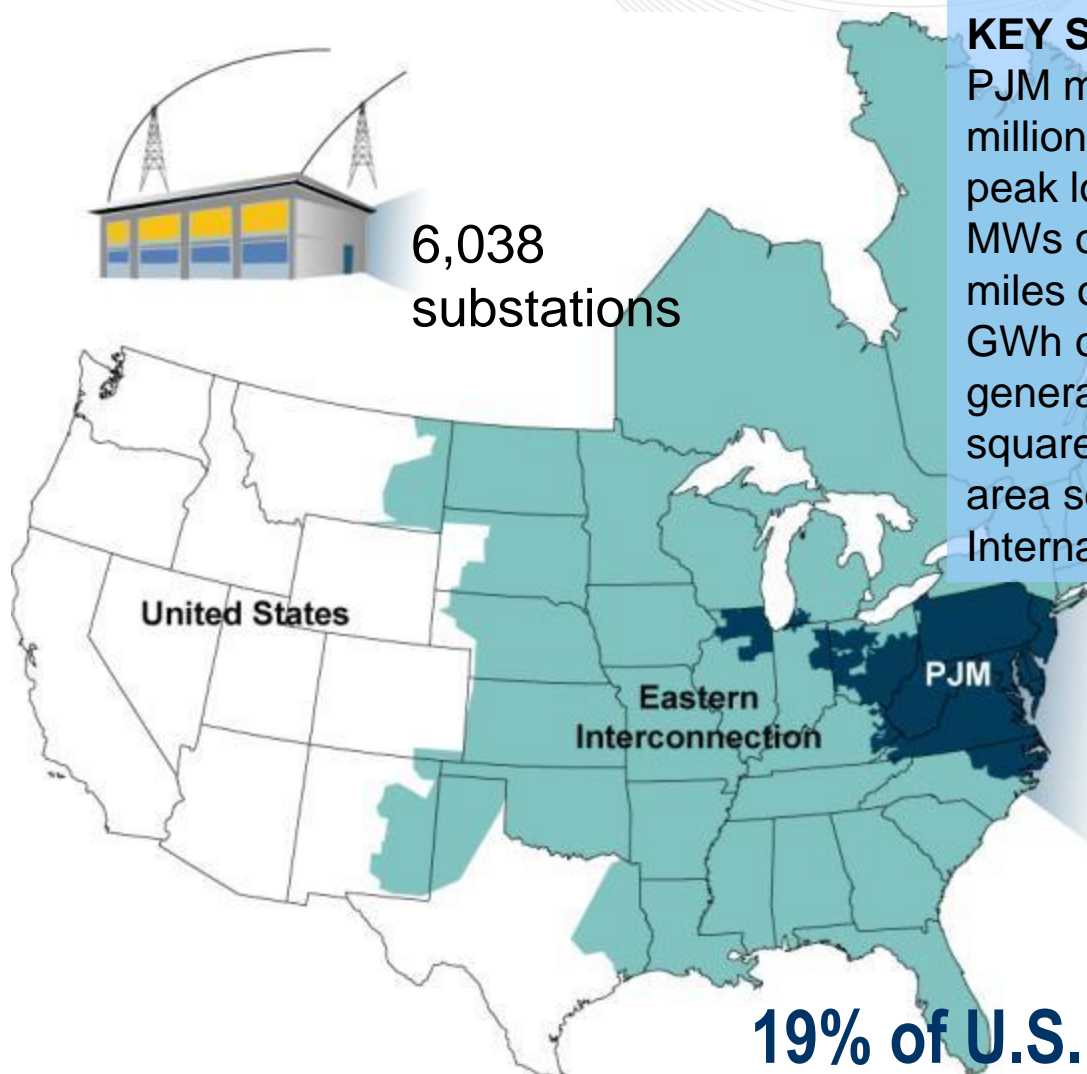
Paul McGlynn
General Manager
System Planning
PJM



6,038
substations

KEY STATISTICS

PJM member companies	600
millions of people served	51
peak load in megawatts	144,644
MWs of generating capacity	164,905
miles of transmission lines	56,250
GWh of annual energy	729,000
generation sources	1,310
square miles of territory	164,260
area served	13 states + DC
Internal/external tie lines	250



26% of generation in
Eastern Interconnection

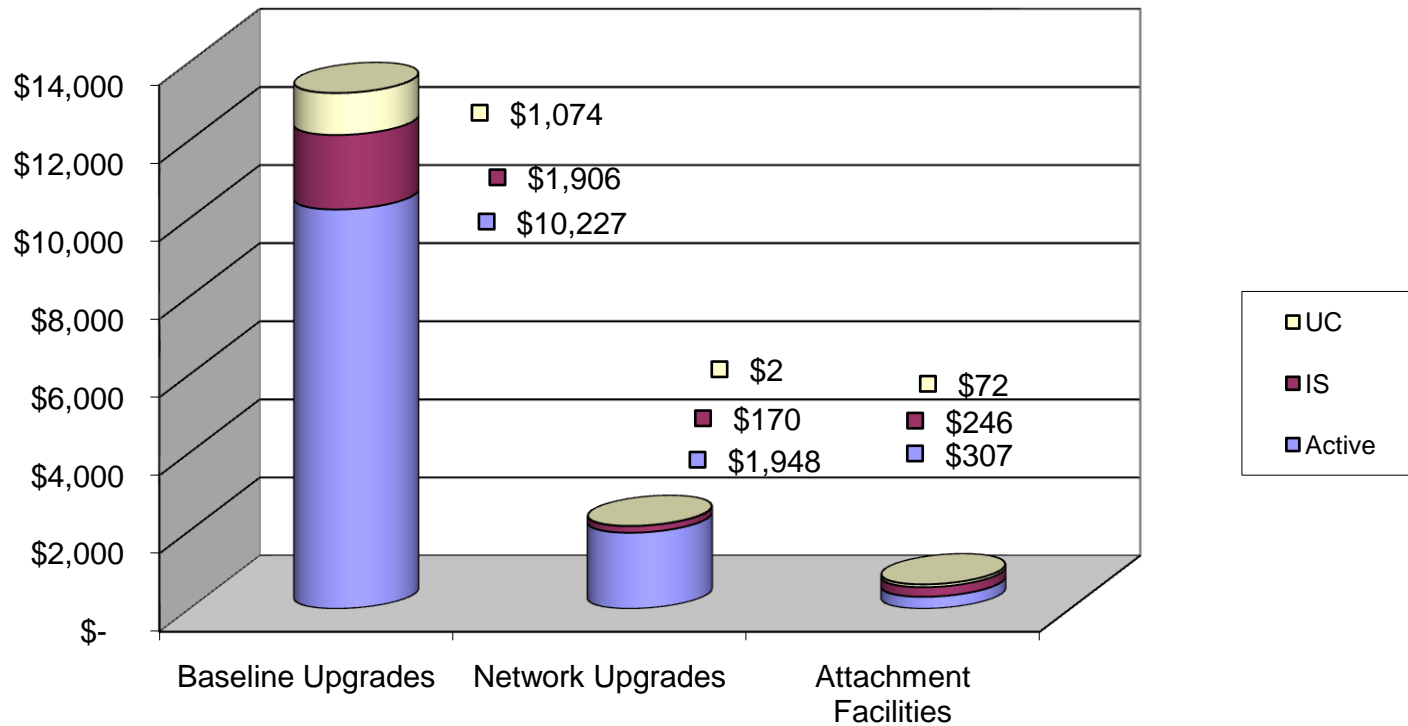
23% of load in
Eastern Interconnection

19% of transmission assets
in Eastern Interconnection

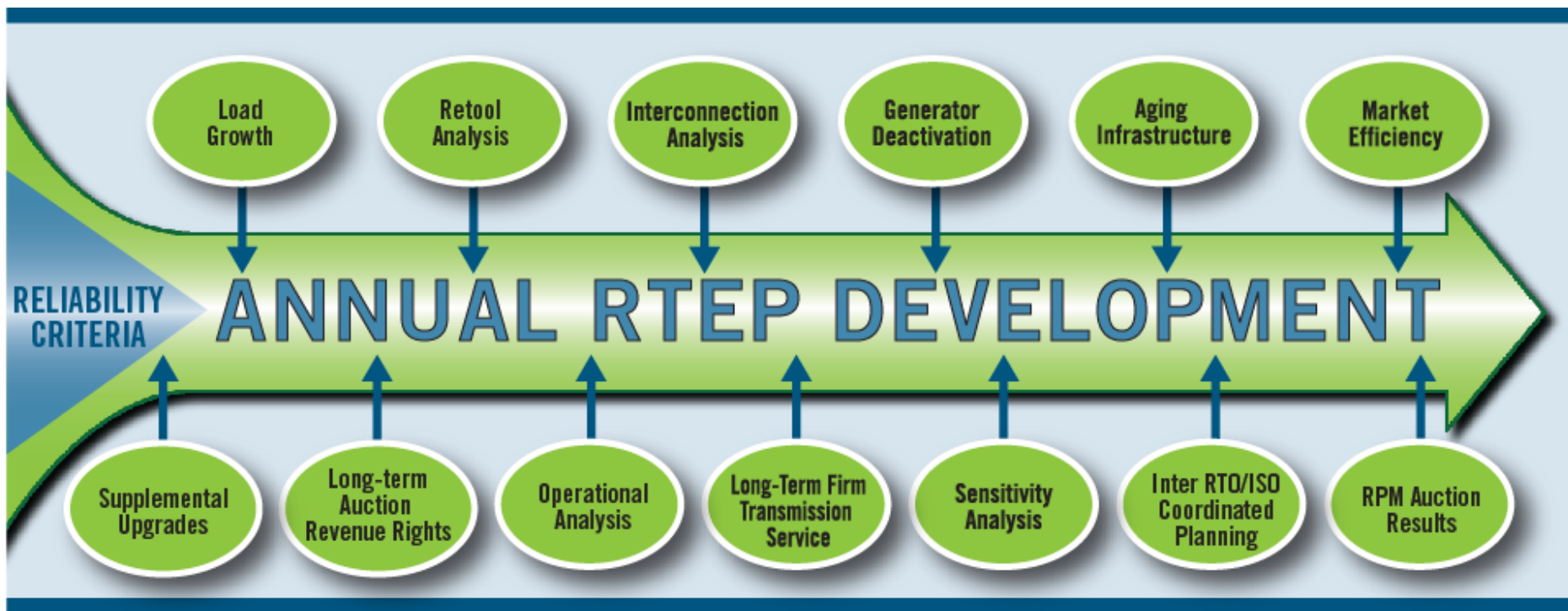
19% of U.S. GDP produced in PJM

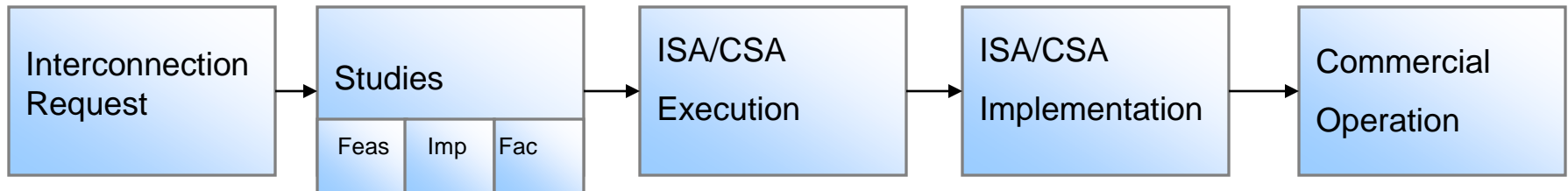
RTEP Process Background – Approved Project Totals

	Active		IS		UC		Totals
Baseline Upgrades	\$	10,227	\$	1,906	\$	1,074	\$ 13,207
Network Upgrades	\$	1,948	\$	170	\$	2	\$ 2,120
Attachment Facilities	\$	307	\$	246	\$	72	\$ 625
Totals	\$	12,482	\$	2,322	\$	1,148	\$ 15,952



Regional Transmission Expansion Plan (RTEP) - Scope





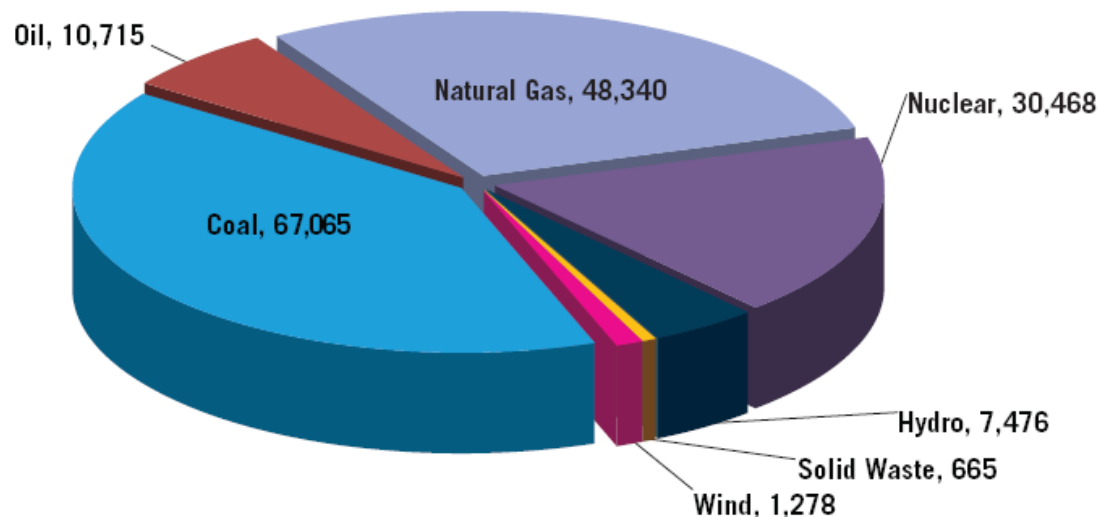
Note: Projects May Drop Out of the Queue at any Time

Nameplate of Installed PJM Generation (2009)

	MW	Percent
Oil	10715	6%
Coal	67065	40%
Natural Gas	48340	29%
Nuclear	30468	18%
Hydro	7476	5%
Solid Waste	665	0%
Wind	1278	1%
	166007	100%

PJM Available Generation by Fuel Source (MW)

The chart reflects the total amount of generation available within PJM. It reflects what each generating unit was designed to produce if needed.



As of 12/31/2008

Nameplate of Renewable PJM Generation (2009)

	MW	Percent
Hydro	7476	5%
Solid Waste	665	0%
Wind	1278	1%
	9419	6%

PJM Renewable Energy Dashboard

<http://www.pjm.com/about-pjm/newsroom/renewable-dashboard.aspx>

PJM Interconnection Queue

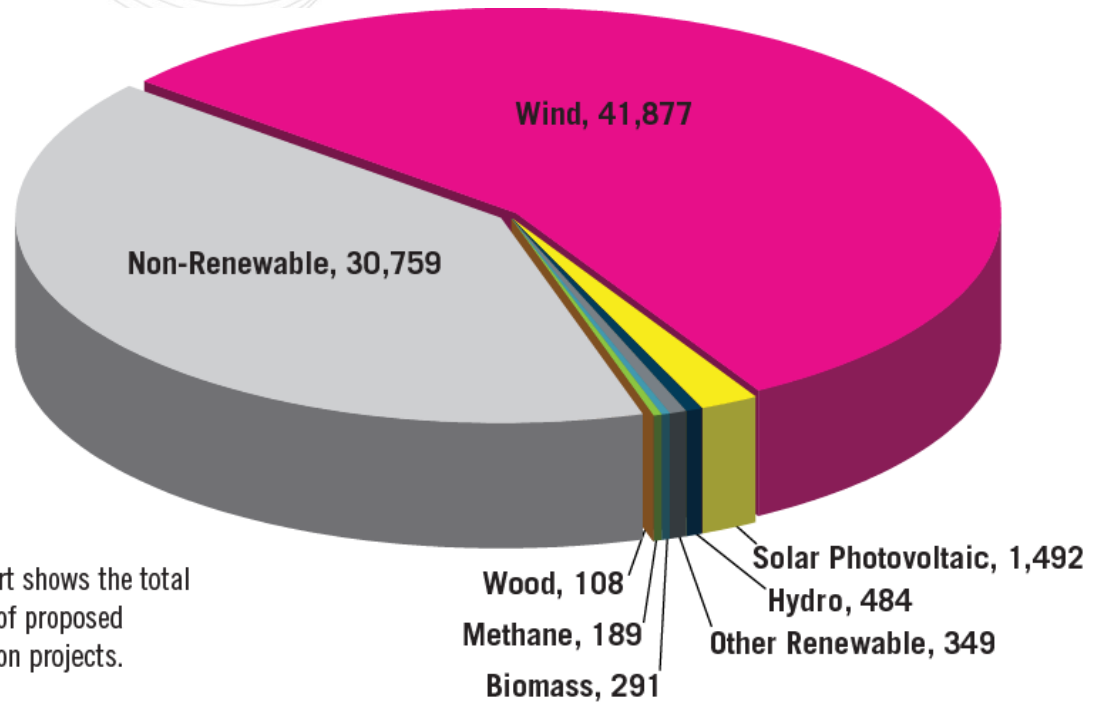
Renewable Requests:

44,790 MW
60% of total requests

Non-Renewable Requests:

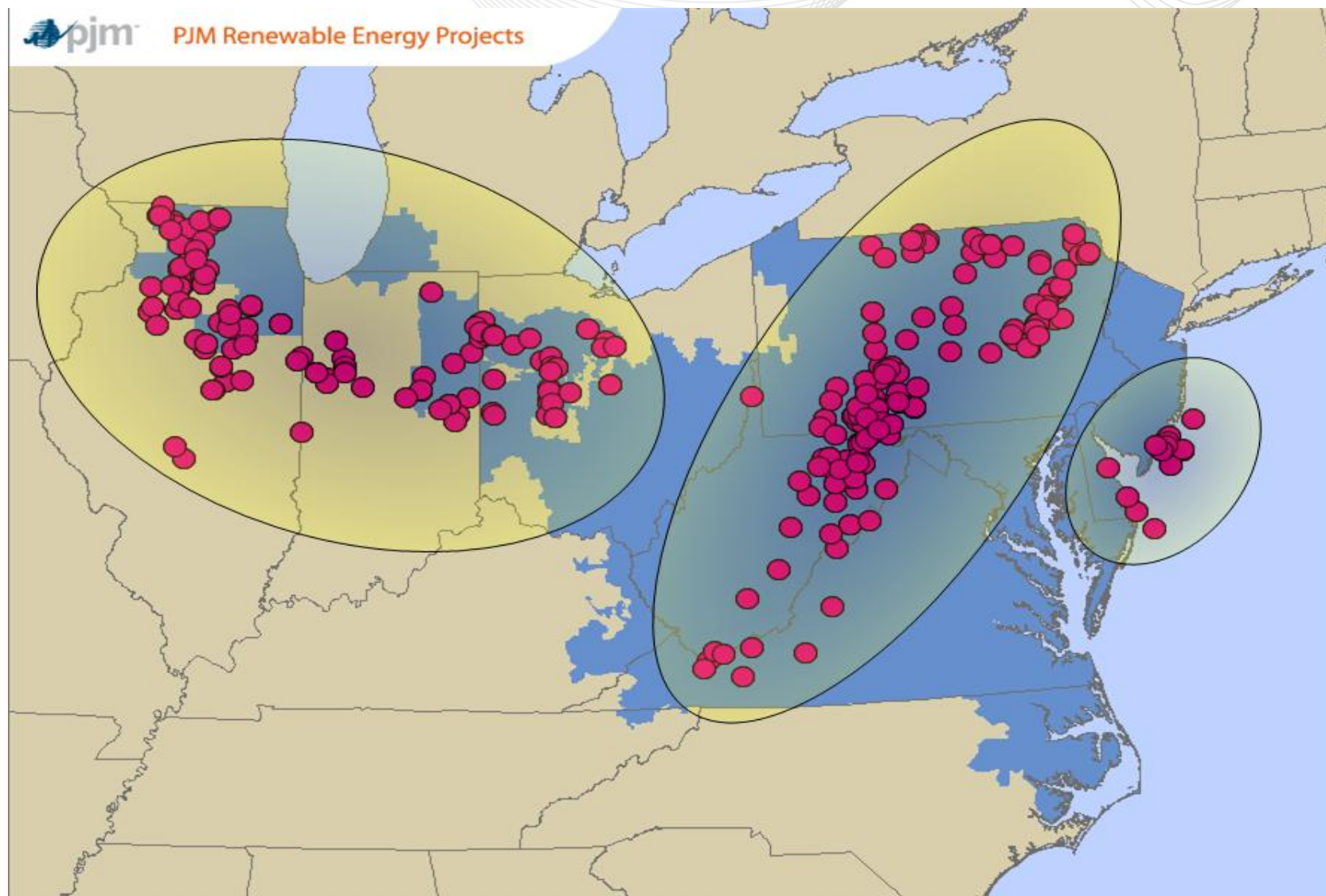
30,759 MW
40% of total requests

This chart shows the total amount of proposed generation projects.



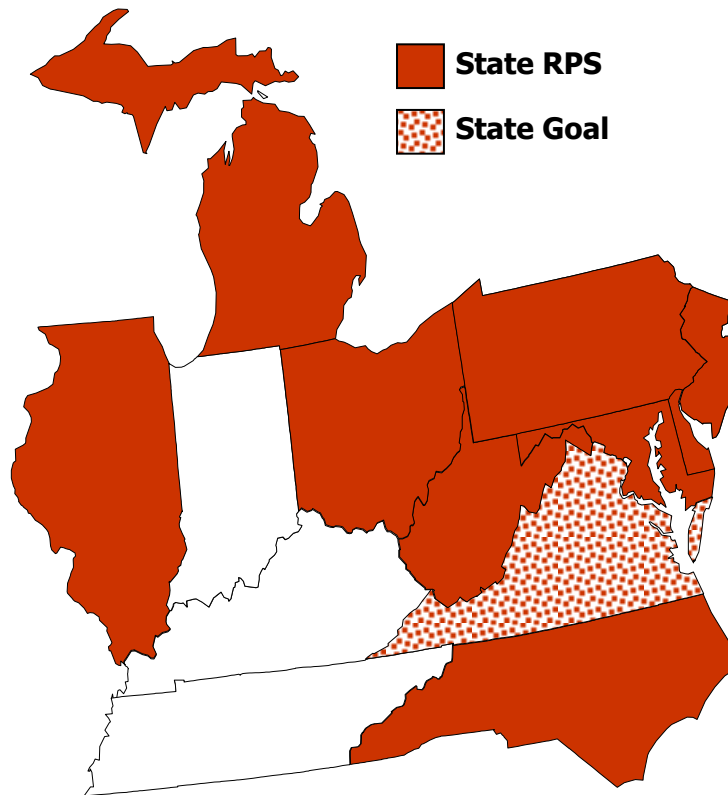
Data valid as of March 31, 2010

Clustered Wind Generation Projects



State Renewable Portfolio Standards (RPS) require suppliers to utilize wind and other renewable resources to serve an increasing percentage of total demand.

State RPS Targets:



- ☀ NJ: 22.5% by 2021
- ☀ MD: 20% by 2022
- ☀ DE: 20% by 2019 ^
- ☀ DC: 20% by 2020
- ☀ PA: 18%** by 2020
- ☀ IL: 25% by 2025
- ☀ OH: 25%** by 2025
- ☀ NC: 12.5% by 2021 (IOUs)
- MI: 10% + 1,100 MW by 2015 ^
- VA: 15% by 2025 ^
- WV: 25%** by 2025 ^

☀ Minimum solar requirement

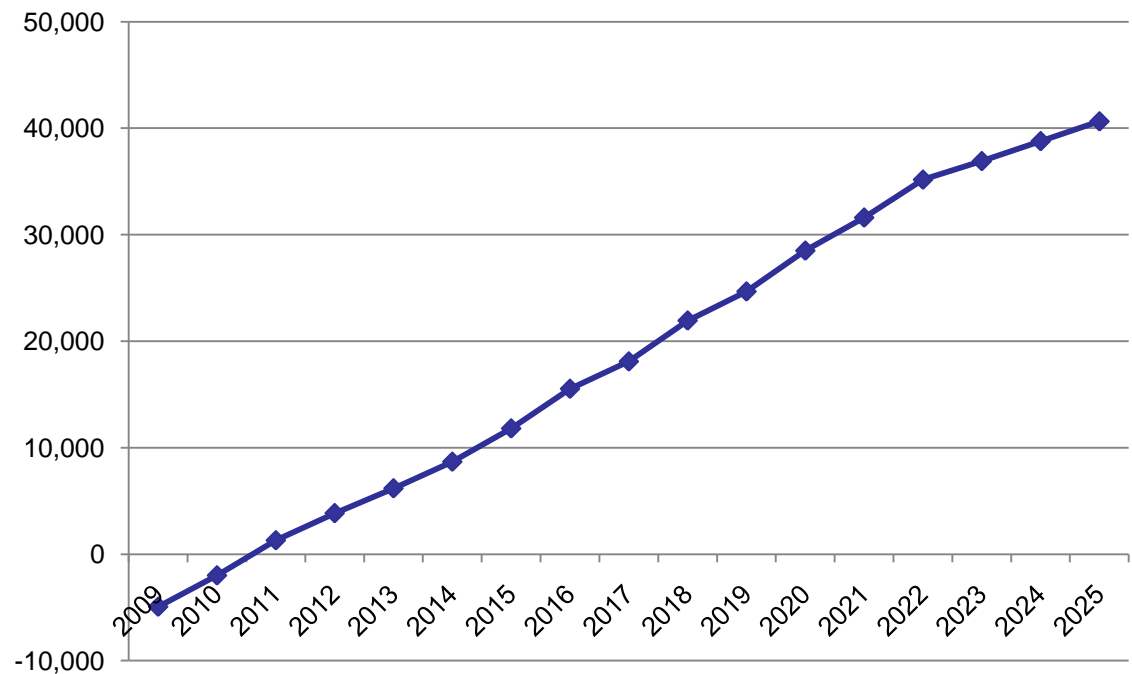
^ Extra credit for solar or customer-sited renewables

** Includes separate tier of "alternative" energy resources

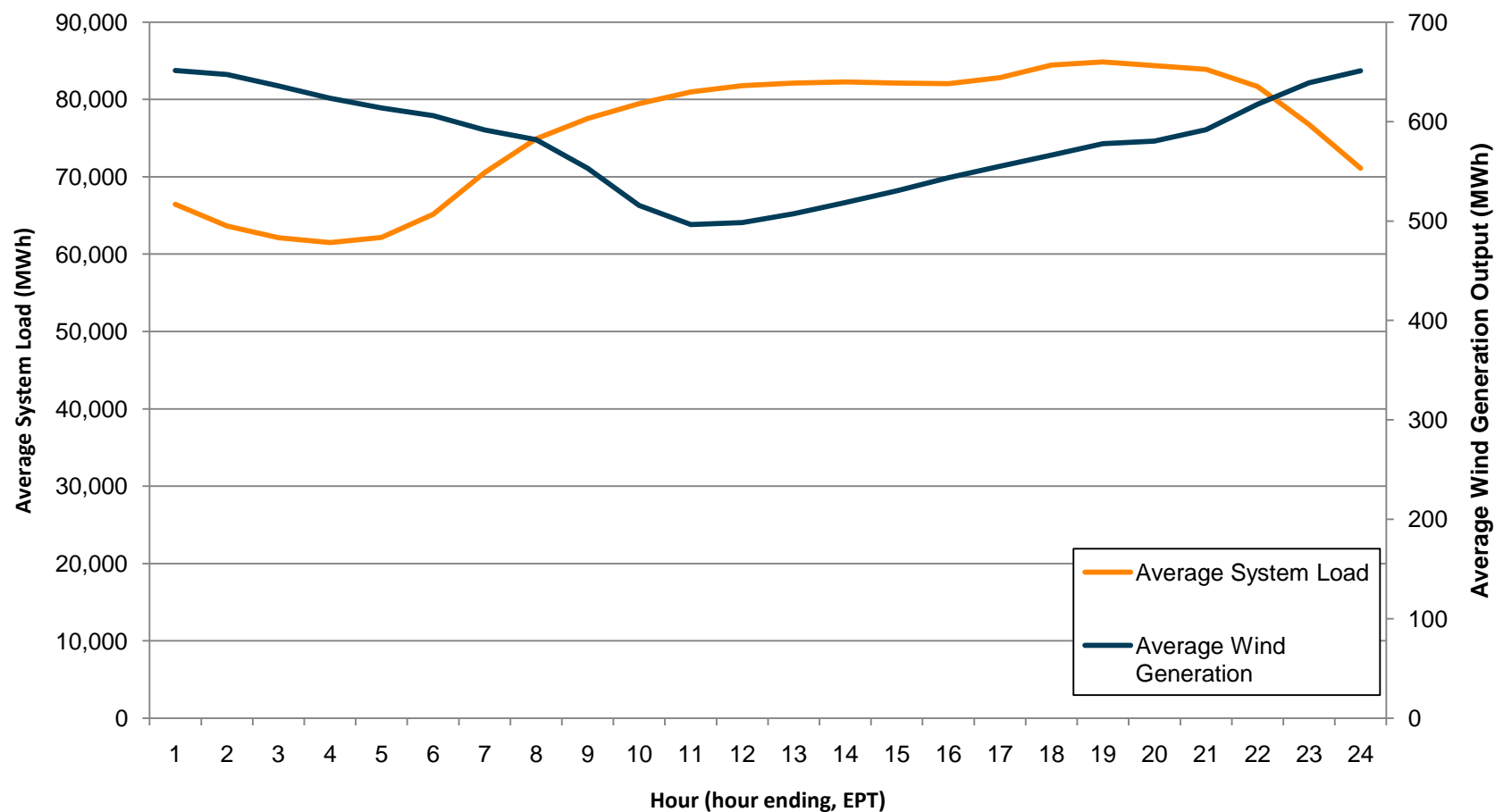
New Renewable Capacity Required due to RPS

Year	New RPS MW needed assuming a 30% CF for existing and future renewable generation
2009	-4,944
2010	-2,000
2011	1,295
2012	3,845
2013	6,175
2014	8,675
2015	11,802
2016	15,525
2017	18,093
2018	21,932
2019	24,664
2020	28,497
2021	31,602
2022	35,161
2023	36,904
2024	38,779
2025	40,636

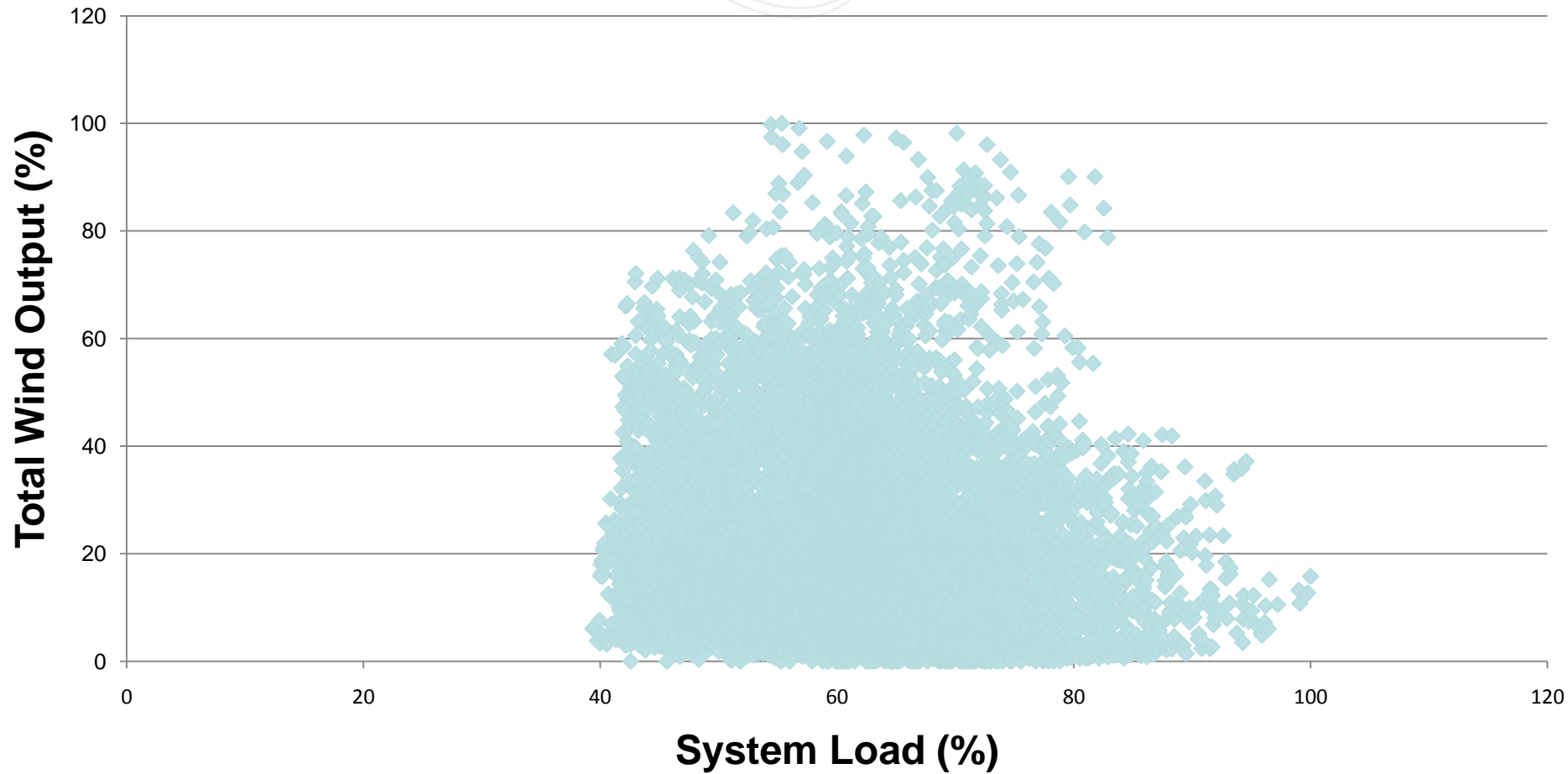
New RPS Nameplate MW needed due to RPS



Comparison of Average Hourly Load vs Average Wind Generation

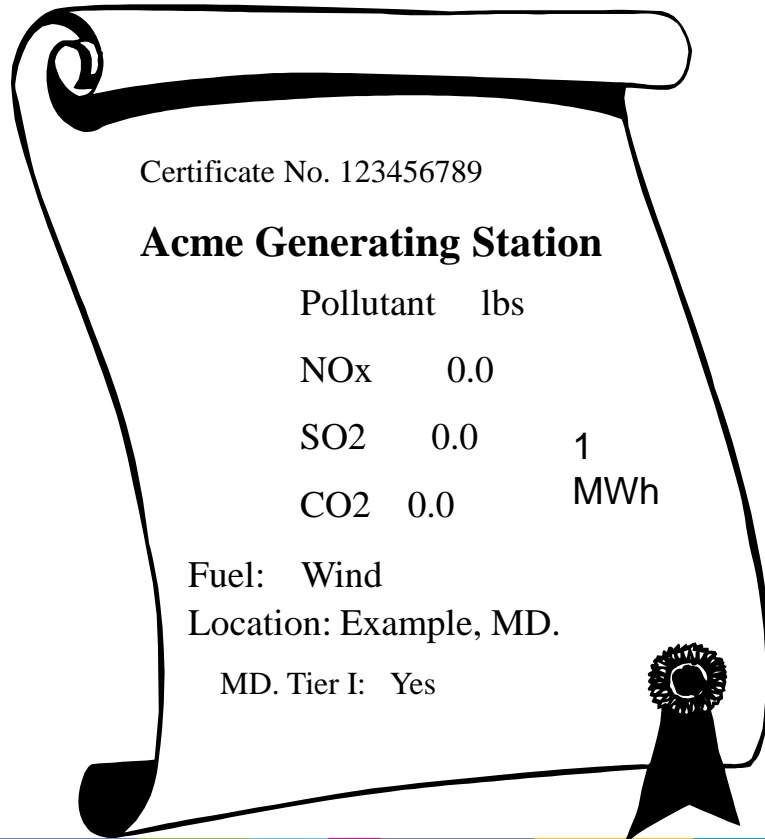


Total Wind vs System Load



- Off-peak planning criteria
- Implemented a centralized wind power forecasting service in April 2009 for use in PJM reliability assessments:
 - Day Ahead (Medium-Term Wind Power Forecast)
 1. predict day-ahead congestion and mitigating strategies
 2. ensure sufficient generation resources are scheduled to meet reserve requirements
 - Real-Time (Short-Term Wind Power Forecast)
 1. evaluate current day congestion
 2. ensure that sufficient generation resources are available to respond to real-time or projected fluctuations in Wind Power Output.
- Implemented changes to improve wind resource management.
 - Generating resources are now able to submit negative price offers, enabling wind resources to submit flexible offers that better reflect the price at which they will reduce output.

GATS - a regional environmental registry and information system that tracks the environmental and fuel attributes of generation.



- Implemented in 2009 , it tracks all PJM generation
- GATS allows renewable energy resources to monetize the premium by creating credits that can be sold to electricity suppliers with obligations to comply with RPS mandates
- Assist energy suppliers in their compliance with state-level Renewable Portfolio Standard (RPS) statutes or renewable policy, applicable emissions and fuel disclosure requirements

- Flexible resources will be needed to offset the impacts of variable generating resources
- New market players:
 - Price Responsive Demand
 - Smart Grid Technologies
 - Energy Storage Resources
 - battery arrays
 - flywheels
 - compressed air energy storage
 - plug-in hybrid electric vehicles (PHEVs)